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Certified Reference Material — Certificate of Analysis

ISO 17034:2016 | ISO/IEC 17025:2017 | ISO 9001:2015

Product ID: IARM-FEL6-18

Product Description: Tool Steel, L6 / T61206

Revision No.: 000
Revision Date: 03/25/2022

Description and Intended Use: This **Certified Reference Material** is covered under the scope of accreditation to **ISO 17034** by LGC Standards - Manchester, NH. As an ISO 17034 certified reference material, appropriate use of this material will fulfill the certified reference material and traceability requirements for use in **ISO 17025** accredited laboratories. This CRM may come in the form of a solid disk, or chips. The intended use of this CRM may include, but is not limited to, the calibration of instruments and the validation of analytical methods.

Certified Values listed in wt.% with associated uncertainties

Al	**0.020**	± 0.001	**As**	**0.0033**	± 0.0008	**B**	**0.0008**	± 0.0005	**C**	**0.718**	± 0.008
Co	**0.007**	± 0.001	**Cr**	**0.71**	± 0.01	**Cu**	**0.027**	± 0.002	**Mn**	**0.605**	± 0.008
Mo	**0.237**	± 0.006	**N**	**0.0064**	± 0.0004	**Nb**	**0.003**	± 0.001	**Ni**	**1.34**	± 0.02
O	**0.0012**	± 0.0003	**P**	**0.013**	± 0.001	**S**	**0.0017**	± 0.0006	**Si**	**0.264**	± 0.008
Ti	**0.0033**	± 0.0007	**V**	**0.008**	± 0.001						

Indicative Values listed in ppm

Fe (96.3%) Mg (7) Sn (20) W (30) Zn (20)

Homogeneity and Uncertainty: "Uncertainty" values, as reported adjacent to certified concentration values, are based on a 95% Confidence Interval. These estimated uncertainties include the combined effects of method imprecision, material inhomogeneity, and any bias between methods. Homogeneity data from experimental XRF results are reflected in both the overall statistics and certified data. Homogeneity samples are selected by a systematic sampling procedure. The number of samples may be determined by equation 1, where N_{prod} is the number of units produced and N_{min} is the number of samples used for homogeneity testing. These samples are arranged in a simple randomized design such that each sample is analyzed multiple times by XRF. Homogeneity may also be determined within sample using an applied version of ASTM E826. A single factor ANOVA is used to calculated uncertainty due to inhomogeneity (U_{hom}). Uncertainty of the material is calculated by equation 2, where H=U_{hom}, S= Standard deviation, t= t-value at 95% CI, and n= number of observations.

$$1.\ N_{MIN} = \max\left(10, \sqrt[3]{N_{PROD}}\right) \qquad 2.\ U_{CRM} = \frac{\sqrt{H^2 + S^2}}{\sqrt{n}} * t$$

Certification Laboratories: Much of the analytical work performed to assess this material has been carried out by laboratories with proven competence, as indicated by their accreditation to ISO 17025. It is an implicit requirement for this accreditation that analytical work should be performed with due traceability, via an unbroken chain of comparisons, each with stated uncertainty, to primary standards such as the mole, or to nationally- or internationally-recognised reference materials. Of the individual results herein, some have traceability (to the mole) via primary analytical methods. Some are traceable to substances of known stoichiometry. Most have traceability via commercial solutions. Furthermore, some results have additional traceability to NIST standards, as part of the analytical calibration or process control.

- LGC Standards - Manchester, NH
- Connecticut Metallurgical, Inc. - East Hartford, CT
- Dirats Laboratories - Westfield, MA
- IMR Test Labs - Lansing, NY
- Applied Technical Services - Marietta, GA
- Luvak Inc. - Boylston, MA
- Instytut Metalurgii Żelaza - Gliwice, Poland
- NSL Analytical Services - Cleveland, OH
- SGS MSi - Melrose Park, IL
- EAG Laboratories - Liverpool, NY
- New Hampshire Materials Laboratory - Somersworth, NH
- Scrooby's Laboratory Service - Benoni, South Africa
- Raghavendra Spectro Metallurgical Laboratory - Bengaluru, India
- IMR Test Labs - Louisville, KY

Instructions for Use: The test surface is on the opposite side of the labeled surface, which includes the material identification. The entire thickness of the unit is certified. However, the user is cautioned not to measure disks less than 2 mm thick when using X-ray fluorescence spectrometry. Each packaged disk has been prepared by finishing the test surface using a lathe. The user must determine the correct surface preparation procedure for each analytical technique. The user is cautioned to use care when either resurfacing the disk or performing additional polishing, as these processes may contaminate the surface. The minimum sample size for chips should be individually evaluated based on the analytical technique used; this would typically be greater than 0.1 grams. The material should be stored in a cool, dry location when not in use.
Chips are not recommended for gas analysis.

Period of Validity: The certification of this material is valid indefinitely, within the uncertainty specified, provided the material is handled and stored in accordance with the instructions stated on this certificate. The certification is nullified if the material is damaged, contaminated, otherwise modified, or used in a manner for which it was not intended.

Kimberly Halkiotis, Global Product Manager

March 25, 2022
Certification Date

ISO 17034 Accredited: Reference Materials Producer, Certificate # 2848.02
ISO/IEC 17025 Accredited: Chemical Testing, Certificate # 2848.01

The following data represents all pertinent information reported as it applies to the chemical characterization of this material.

	Al	As	B	C	Co	Cr	Cu	Fe	Mg	Mn	Mo	N	Nb
1	0.0168	0.0020	0.0001	0.6860	0.0040	0.6700	0.0180	95.960	0.0004	0.5610	0.2080	0.0055	0.0004
2	0.0170	0.0025	0.0002	0.6938	0.0040	0.6740	0.0210	96.000	0.0010	0.5690	0.2100	0.0060	0.0008
3	0.0172	0.0026	0.0003	0.7060	0.0040	0.6780	0.0210	96.050		0.5880	0.2148	0.0060	0.0011
4	0.0179	0.0027	0.0009	0.7070	0.0042	0.6869	0.0250	96.700		0.5932	0.2240	0.0060	0.0014
5	0.0184	0.0028	0.0009	0.7120	0.0057	0.6910	0.0254	96.790		0.5960	0.2257	0.0061	0.0018
6	0.0185	0.0029	0.0010	0.7140	0.0058	0.6920	0.0258			0.5980	0.2263	0.0068	0.0020
7	0.0188	0.0030	0.0010	0.7150	0.0059	0.6970	0.0260			0.5985	0.2300	0.0069	0.0030
8	0.0190	0.0032	0.0018	0.7190	0.0060	0.7000	0.0270			0.6000	0.2300	0.0070	0.0030
9	0.0190	0.0040	<0.0004	0.7190	0.0068	0.7000	0.0275			0.6000	0.2380	0.0071	0.0030
10	0.0190	0.0054	<0.0010	0.7200	0.0070	0.7010	0.0280			0.6050	0.2400		0.0040
11	0.0190	0.0056	<0.005	0.7200	0.0070	0.7020	0.0280			0.6100	0.2410		0.0041
12	0.0200	<0.001		0.7230	0.0073	0.7080	0.0293			0.6100	0.2410		0.0050
13	0.0200	<0.002		0.7280	0.0079	0.7130	0.0293			0.6104	0.2417		0.0060
14	0.0200	<0.005		0.7300	0.0080	0.7160	0.0294			0.6110	0.2420		<0.0010
15	0.0220	<0.005		0.7400	0.0084	0.7180	0.0298			0.6120	0.2422		<0.0010
16	0.0220	<0.0050		0.7480	0.0100	0.7200	0.0300			0.6150	0.2436		<0.002
17	0.0230				0.0110	0.7220	0.0310			0.6156	0.2450		<0.005
18	0.0240					0.7230	0.0310			0.6210	0.2450		<0.005
19	0.0241					0.7320	0.0360			0.6240	0.2460		
20	0.0243					0.7450				0.6250	0.2500		
21						0.7478				0.6443	0.2570		
22											0.2640		
Mean	0.0200	0.0033	0.0008	0.7176	0.0066	0.7065	0.0273	96.300	0.0007	0.6051	0.2366	0.0064	0.0027
STDV	0.0024	0.0012	0.0006	0.0155	0.0020	0.0213	0.0041	0.4087	0.0004	0.0185	0.0142	0.0006	0.0017
Certified	**0.020**	**0.0033**	**0.0008**	**0.718**	**0.007**	**0.71**	**0.027**	**(96.3)**	**(0.0007)**	**0.605**	**0.237**	**0.0064**	**0.003**
U_{CRM}	0.001	0.0008	0.0005	0.008	0.001	0.01	0.002			0.008	0.006	0.0004	0.001
Methods	I,IM,O,X	I,IM,O,X	I,IM,O	C,O	I,IM,O,X,G	I,O,X,G	I,IM,O,X	I,O,X	IM,I	I,O,X,G	I,IM,O,X,G	F,O	I,IM,O,X,G

	Ni	O	P	S	Si	Sn	Ti	V	W	Zn
1	1.2400	0.0007	0.0088	0.0001	0.2311	0.0008	0.0019	0.0040	0.0017	0.0007
2	1.2620	0.0009	0.0100	0.0006	0.2360	0.0009	0.0021	0.0040	0.0018	0.0030
3	1.2880	0.0010	0.0100	0.0010	0.2390	0.0010	0.0025	0.0049	0.0061	
4	1.2990	0.0014	0.0102	0.0010	0.2460	0.0022	0.0030	0.0050	<0.01	
5	1.3300	0.0014	0.0125	0.0010	0.2500	0.0025	0.0030	0.0081	<0.01	
6	1.3310	0.0014	0.0125	0.0011	0.2510	0.0032	0.0030	0.0083		
7	1.3310	0.0016	0.0130	0.0011	0.2510	<0.001	0.0030	0.0084		
8	1.3330		0.0133	0.0015	0.2651	<0.0010	0.0034	0.0088		
9	1.3350		0.0134	0.0019	0.2660	<0.005	0.0045	0.0088		
10	1.3400		0.0140	0.0020	0.2663	<0.01	0.0047	0.0089		
11	1.3440		0.0140	0.0020	0.2700		0.0050	0.0090		
12	1.3480		0.0140	0.0020	0.2700		<0.002	0.0090		
13	1.3480		0.0140	0.0020	0.2708		<0.002	0.0100		
14	1.3540		0.0140	0.0030	0.2730		<0.002	0.0100		
15	1.3600		0.0140	0.0030	0.2750		<0.005	<0.005		
16	1.3600		0.0150	0.0045	0.2760		<0.01	<0.01		
17	1.3681		0.0151	<0.001	0.2760					
18	1.3757		0.0160	<0.001	0.2810					
19	1.3762		0.0167	<0.005	0.2820					
20	1.3770				0.2850					
21	1.4000				0.2880					
22										
Mean	1.3381	0.0012	0.0132	0.0017	0.2642	0.0018	0.0033	0.0077	0.0032	0.0019
STDV	0.0389	0.0003	0.0021	0.0011	0.0167	0.0010	0.0010	0.0022	0.0025	0.0016
Certified	**1.34**	**0.0012**	**0.013**	**0.0017**	**0.264**	**(0.002)**	**0.0033**	**0.008**	**(0.003)**	**(0.002)**
U_{CRM}	0.02	0.0003	0.001	0.0006	0.008		0.0007	0.001		
Methods	I,O,X,G	F	I,IM,O,X,G	C,O,I,X,G	I,O,X,G,IM	I,IM,O,X	I,IM,O,X	I,IM,O,X	IM,I,X,G	IM,I

Legend: W = Classical, C = Combustion, F = Fusion, A = AA or GFAA, I = ICP or DCP, IM=ICP-MS, D = DC Arc, O = AES, X = XRF, G = GDAES or GDMS, H = Hollow Cathode AES